VSB TECHNICAL
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| FACULTY OF ELECTRICAL
ENGINEERING AND COMPUTER
SCIENCE

| DEPARTMENT OF CYBERNETICS
AND BIOMEDICAL ENGINEERING

Doctoral Dissertation Review Report submitted to Polish-Japanese Academy of Information Technology in Warsaw

Author: **Mgr inż. Bernadetta Bartosik**

Title: "**A method for measuring trust and attractiveness of presented faces based on brain activity measurements and machine learning**"

Scientific Supervisors: **dr hab. Grzegorz Marcin Wójcik, prof. UMCS, prof. PJATK, dr hab. Aneta Brzezicka, prof. SWPS**

Scientific Discipline: **Technical Information Technology and Telecommunications**

This review has been carried out in response to invitation of the Head of Scientific Council for Computer Science Discipline - **Prof. dr hab. Maria Elżbieta Orłowska** from 22.06.2023.

The purpose of this assessment is to determine whether Mgr inż. Bernadette Bartosik's doctoral dissertation is valid and aligns with the requisites for theses at this stage of education. It also satisfies the criteria delineated in the following sections:

1. **Relevance of the chosen topic.**

Ad. 1. The impact of first impressions and physical appearance on human interaction cannot be denied. A person's appearance, behavior, and demeanor have always played a significant role in determining the trajectory of a relationship. This thesis summarizes this reality and demonstrates how seemingly innocuous factors like facial appearance and clothing can have a significant impact on perceptions of health and trustworthiness. The importance of examining how impressions is formed in various sectors, from the professional to the social, cannot be overstated. In support of this argument, the author refers to studies that highlight the influence of facial appearance on political and legal outcomes.

Specifically, the thesis focuses on the implementation of machine learning-based techniques for electroencephalography (EEG) signal classification and analysis. In this context, EEG signal classification and analysis are important research areas for applications such as medical diagnosis, brain-computer interfaces, and understanding the brain. Therefore, the topic is relevant and current.

Although the topic and its exploration are commendable, it would be beneficial to include a more recent discussion of current literature. Particularly in light of recent advances in machine learning models. This thesis focuses exclusively on regression, however other state-of-the-art machine learning techniques are not discussed. Thus, I believe that reviewing more recent studies that examine deeper layers of these dynamics could provide valuable insight into how these dynamics can be better understood.

Overall, based on my professional experience, I believe that this contemporary topic is of significant interest to many scientific communities (e.g., Technical Information Technology) around the world.

2. Fulfillment of dissertation objectives and contribution to the scientific field.

Ad. 2. The PhD candidate defined the following <u>hypotheses</u>:
- **H1**: It is possible to predict trust ratings based on the survey participant's personality traits.
- **H2**: Attractiveness ratings can be predicted based on the survey participant's personality traits.
- **H3**: There are personality traits that have a significant impact on both trust and attractiveness ratings.
- **H4**: One can predict the trust decision regarding the presented faces based on the average electrical charge of the brain.
- **H5**: It is possible to predict the attractiveness rating of the presented faces based on the average electrical charge of the brain.

Further, the research objectives were divided into two parts - pilot and main. In addition, five hypotheses were formulated, each interconnected with the research objectives.

The motivation behind the selected topic, as well as the hypotheses and research goals, have been thoroughly reviewed in the context of prevailing societal trends and gaps present in the existing literature. The subject of the work is extremely interdisciplinary as it combines various scientific fields, such as computer science, biomedical engineering, neurology, and psychology.

Although the author has presented some interesting findings, it would benefit from comparing them with more contemporary machine learning techniques. It is, however, possible to assume that the hypotheses were met based on the results obtained.

3. Dissertation content.

Ad. 3. In total, the dissertation contains 85 pages, 102 references, 7 chapters (including the References), 25 figures, 14 tables, and 15 equations. The first chapter provides a brief overview of the topic as well as motivations, research goals, and hypotheses. The second chapter discusses the basics of electroencephalography and the structure of the brain. It then proceeds to explain methods for analyzing signals in the third chapter. In the fourth chapter, the results of the experiments are discussed. Following that, the fifth chapter presents the results obtained. The sixth chapter is a discussion. Finally, the bibliography is presented in the seventh chapter (without a specific number). Several grammar errors can be found in the thesis, which is written in English.

Based on EEG data analyzed through a regression model in response to photos implemented in the SPSS statistical calculation program, the study examines findings about trust and attractiveness. It took place at the Maria Curie-Skłodowska University in Lublin and was conducted with a clinical EGI-EEG system equipped with a cap with 256 electrodes. Experiments (tests) were planned using OpenSesame. Participants in the experiment were required to examine pictures of faces taken from two publicly available databases: MR2 and DEFSS. A total of 24 photographs were selected by the author for this dissertation. The experiment was conducted on 61 right-handed males aged 18 to 23. By using a logistic regression model, the results of preprocessed data were as follows: 78% for trust and 76% for attractiveness.

In my opinion, the thesis lacks a coherent structure at some points. In the signal processing section, the author did not consider any novel techniques used for EEG preprocessing. This is an important aspect as modern preprocessing techniques are the basis for most EEG data analysis and could significantly affect classification results. The author should have discussed the benefits and drawbacks of different preprocessing techniques. Additionally, it would have been useful to discuss the potential of emerging technologies such as neural networks for EEG preprocessing and classification. The figures should have been created in a higher resolution, sometimes they are hard to follow from a visual perspective. The same applies to tables which are badly formatted and the caption is incorrectly used underneath the table. The research protocol should be more cohesive in the experiment part. Additionally, some of the examples of EEG signals before and after preprocessing are missing.

4. Positive remarks of the thesis.

Ad. 4. Motivating factors, research objectives, and hypotheses are outlined precisely. In spite of its concise nature, the work effectively introduces research issues and solutions. There has been a resolution to the described problem.

The content and interdisciplinary nature of this dissertation illustrate the author's ability to define a scientific problem, offer solutions, and confirm those solutions through experimentation. In addition, the PhD candidate has contributed to the creation of two scientific papers in a well-known journal with a high reputation in the field of neurology, which is closely related to the topic of this dissertation.

Additionally, the proposed research is interesting and innovative.

5. Issues for discussion.

Ad. 5. Please answer below questions/remarks:
- In the whole text, the citations are not arranged in the correct order.
- There is a lack of definitions of abbreviations.
- The figures are of poor quality and the captions are inadequate. Table captions are incorrectly used.
- A lack of comparison between this study's results and other authors.
- Have you been involved in any research projects?
- Are there any other montages besides "10-20"?
- Would you be able to provide samples of the signals?
- How did you determine the number of participants? Is there a particular reason why you chose 61?
- Have you considered using hybrid methods?
- Why did you used only logistic regression, why you did not consider of using another's ML-based techniques?
- Have you considered expanding your experiments to include other biomedical signals? Could you specify which ones and how they could be beneficial for classification?
- In the Research experiment section on p. 54, you mentioned that: „As a result of the statistical analysis of the data collected during the pilot experiment, 24 photos were

specified (Figure 4.7) that were used for the study." Could you be more specific about which statistical analysis was used and how 24 images were chosen?

- What are your further research plans?

6. Summary assessment.

Ad. 6. The thesis discusses the importance of first impressions, particularly those associated with facial appearances, in human interactions. Using EEG signals and machine learning methodologies, Mgr inż Bernadette Bartosik delves deep into understanding how these perceptions affect judgments on trust and attractiveness. There is a great deal of relevance to the chosen topic across a variety of scientific disciplines.

Although the research objectives and hypotheses are clearly stated and the interdisciplinary nature of the research is commendable, there are some areas in which the thesis could have been strengthened. A broader discussion of contemporary machine learning techniques and a focus on novel preprocessing methods for EEG signal analysis might have been beneficial to the paper. There are structural inconsistencies in the thesis, as well as issues with the graphical representation. Furthermore, the list of issues provided in section 5 provides valuable insight into the author's reflection and response.

In a positive light, the concise nature of the dissertation did not compromise the depth of the research. It is evident from the publications in recognized neurology journals that the research carried out is relevant and important.

In conclusion, Mgr inż Bernadette Bartosik's doctoral dissertation holds value in the scientific community. I recommend the work of Mrs. Bernadetta Bartosik for defence.

Ostrava 25.08.2023

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